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IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of:

NEUSCHUTZ, Mark, et al. Examiner: PATEL, Nihir B.

Serial No.: 09/876,227 Group Art Unit: 3743

Filed: 6/8/01

Title: USE OF PCM's IN HEAT SINKS FOR ELECTRONIC COMPONENTS

BRIEF ON APPEAL

Mail Stop - Appeal Brief - Patents
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Sir:

Real Party in Interest

This application is assigned to Merck Patent Gesellschaft, by means of an assignment recorded at reel 012231 and frame 0740.

Related Appeals and Interferences

There are no related Appeals or Interferences.

Status of Claims

Claims 1-21 are pending. Claims 3 and 4 are withdrawn.

Status of Amendments

Appellants' Reply subsequent to Final Rejection filed March 29, 2004 presented minor amendments to claims 20 and 21 for entry. These minor corrections to claims 20 and 21 were supplied in order to provide antecedent basis for terms used therein, and to correct an inadvertent error. Support for the amendment was evident for example, from Figure 2 of the present application. Although the Advisory Action mailed July 13, 2004 fails to indicate the status of this amendment (see item number 7 thereon) Appellants' representative was informed in a telephone conversation with the Examiner that the amendment was denied entry.

Summary of Invention

The present invention is directed to a device for cooling heat-generating electrical or electronic components having a non-uniform output profile, comprising a heat-conducting unit (1) and a heat-absorbing unit which contains a phase change material (4), wherein the phase change material is arranged in such a way that heat flow from the electrical or electronic component is_preferentially to the heat-conducting unit (1) and a majority of heat flow to the phase change material from the electrical or electronic component occurs only when the temperature of the heat-conducting unit (1) exceeds phase change temperature T_{PC} of the phase change material. See the specification at page 5, lines 13-16 and page 6, lines 15-19.

Issues

The issues remaining outstanding in the Final Rejection mailed January 28, 2004, are the

rejections under 35 U.S.C §102 and 103.

Grouping of Claims

It is respectfully submitted that separate basis for patentability exists for claims 14-18, claims 17- 19 and claims 20-21.

Argument

Claims 1, 2 and 5 - 21 remain rejected under 35 U.S.C §102 over Laing (see the Advisory Action, page 2). Laing discloses a cooling device for a semiconductor apparatus comprising a chamber enclosing a non-metallic crystal forming material which can undergo a phase change at a temperature which corresponds to the desired operating temperature of the semiconductor component. More specifically, the semiconductor component that is in heat conductive communication is substantially thermally insulated (col. 2, lines 58-62). The operational nature of the Laing cooling device requires that there is a prerequisite temperature (optimum operating temperature of the semiconductor) which must be met before the crystal forming material will actually undergo the phase change and result in cooling (col. 2, lines 62-67). Moreover, the layers of the crystal forming material which are directly adjacent to the semiconductor will undergo a phase change and melt while those layers which are further removed from the semiconductor will remain substantially at room temperature (col. 2, line 67 - col.3, line 5).

Thus, in the Laing device, the electronic component is rapidly heated to the operating temperature, since, before that temperature is reached, the phase change material (in intimate contact therewith) does not dissipate heat. The semiconductor component of the Laing device is

in fact considered substantially thermally insulated (col.2, lines 60-61). As a result, the device of Laing is clearly of the conventional sort of heat sink design where the phase change material first has to heat before the heat can be dissipated via the cooling fins. There can be no loss of heat from the system until the semiconductor reaches the critical optimum temperature, as is desirable where fast heat up to operating temperature is needed.

However, at page 3, the September 23, 2003 Office Action argues that Laing *does* disclose a device "wherein the phase change material is arranged in such a way that the heat flows from the electrical or electronic component is [sic] preferentially to the heat conducting unit 1 (see FIG. 1) and a majority of heat flow to the phase change material from the electrical or electronic component occurs only when the temperature of the conducting unit 1 exceeds phase change temperature of the phase change material." In actuality, this interpretation of FIG. 1 of the patent is impossible. In order for a majority of heat flow to the phase change material from the electronic component to occur *only* when the temperature of the conducting unit exceeds phase change temperature of the phase change material, there would have to be some means in the patent to prevent heat flow to the phase change unit unless the heat conducting unit (the fins in the patent) were at a temperature exceeding the phase change temperature of the phase change material. Since the path to the fins in the patent is *interrupted* by the phase change material, in order to insure that heat is not dissipated until the phase change temperature is reached, such interpretation of the drawing as in the Office Action is simply not possible.

While the Final Rejection argues that the fins are not only coupled to the phase change material but also to the electronic component, the patent drawing clearly shows phase change material to be disposed between the electronic component and the fins. Thus, no heat flow can

reach the fins until heat is dissipated by the phase change material, which dissipation does not occur until the phase change material reaches phase change temperature. Moreover, even if the situation was as described in the Final Rejection, heat would flow from the source to *both* the fins and the phase change material - not to the phase change material *only* when the temperature of the fins exceeds the phase change temperature of the phase change material.

Clearly, the patent drawing can neither anticipate nor suggest heat flow to the fins from the electrical or electronic component *only* when the temperature of the fins exceeds the phase change temperature. Instead, heat flow in the reference figure goes to the heat conducting unit (the fins) only *after* the temperature of the phase change material is exceeded. Thus, heat flow to the phase change material in the reference occurs *long before* the temperature of the heat conducting unit exceeds the phase change temperature of the phase change material.

The foregoing interpretation of the reference is *not* violative of the laws of thermodynamics, as alleged in the Advisory Action. It is believed that this statement in the Advisory Action reflects a misunderstanding of the orientation of the components in the reference. In the reference, the phase change material blocks the flow of heat from the electronic component to the cooling fins. See, for example, figure 1 of the drawing, where the phase change material (3) and (4) is clearly disposed between the electronic component, the diode (1) and the cooling fins (2). Thus, the phase change material acts like a "switch." Until the phase change temperature of the phase change material is reached, the phase change material absorbs the heat output from the diode, and does not emit that heat to the fins. This is how a phase change material works; specifically, a phase change material absorbs heat until the phase change temperature is reached, at which time the phase of the material changes, and heat is released to

the surrounding area. This construction is desirable in the reference, inasmuch as it is patentees' intent to prevent heat from being rapidly dissipated from the diode, i.e., by the cooling fins, until the operating temperature of the diode is reached. Thus, the phase change material is selected as a "switch" wherein the heat is not vented outside the construction, i.e., by the fins, until the diode has had an opportunity to reach operating temperature. This is thoroughly explained, for example, at column 2, lines 58 - column 3, line 5. Patentees teach that heat transfer through convection by the fins is to be prevented until such time as operating temperature of the diode is reached. See also column 3, lines 14 - 23. In this orientation, of course, the laws of thermodynamics *are* observed. Heat flows from the high temperature surface to the cold temperature surface; specifically, from the diode to the phase change material, which does not give off heat until phase change temperature is reached. Then, the heat flows again from the high temperature surface, the phase change material, to the cold temperature surface, the fins. The situation described in the last sentence of the Advisory Action, that the temperature of the fins is equal or lower than the temperature of the phase change material, and the temperature of the phase change material higher or equal to the fins, clearly occurs in the above description of Laing's invention.

Thus, there can be no anticipation of the presently claimed invention, wherein the phase change material acts as an "overflow reservoir" absorbing extra heat which is too great to be adequately dissipated by the fins. In the present invention, the phase change material "reservoir" absorbs such overflow heat, until such time as the fins have dissipated sufficient heat so that they can absorb the overflow back out of this "reservoir" of phase change material.

With respect to claims 2, and 5-13, mentioned at page 2 of the Final Rejection, these

claims are dependent upon claim 1, and thus also cannot be anticipated by the reference.

With respect to claim 14, rejected under 35 U.S.C §102(b) over Laing at page 2 of the Final Rejection, as discussed above, the reference in no way discloses a device wherein heat flows from the heat source to the heat sink (the fins), and flows from the heat sink to the heat absorbing component when the heat sink temperature exceeds the phase change temperature of the phase change material. Instead, in the reference, heat flows from the phase change material to the heat sink, and only when the temperature of the phase change material is exceeded. Heat flow is not *from* the heat sink to the phase change material, as in claim 14, but quite the opposite. Thus, this claim also cannot be anticipated by the reference. Similar issues apply to claim 15, which is not included in the statement of the rejection at page 2 of the Final Rejection, but is apparently rejected none-the-less, based on the discussion at page 3 of this Office Action. While it is noted that, at page 3 of the Final Rejection, it is argued that "intended use" statements in the claims are not given any weight, the above noted language represents *not* an intended use but defines orientation of the components of the device claimed. Thus, the orientation of the components, which direct heat flow in a way which is neither disclosed or suggested in the reference, must be given weight. In short, mapping of the heat flow path is a apparatus limitation.

With respect to claim 16, similar issues apply. The prior art neither discloses nor suggests the *apparatus configuration* in which heat flows from the heat generating electric or electronic component to the heat sink, and from the heat sink to the heat absorbing component when the heat sink temperature exceeds the phase change temperature of the phase change material. The configuration disclosed in the reference is quite the opposite, as discussed above.

With respect method claims 17-19, as the reference cannot disclose a *method* for absorbing heat in which heat flows from a heat sink to a heat absorbing component when the heat sink temperature exceeds the phase change temperature of the phase change material, inasmuch as the flow in the reference is the opposite; heat flows from the phase change material to the heat sink only when the phase change temperature is exceeded. Similar issues apply to claims 18 and 19, which are dependent upon claim 17.

With respect to claims 20 and 21, these claims are dependent upon claims 1 and 14, respectively, and also are not anticipated as discussed above.

In conclusion, ample basis to overturn all of the rejections under 35 U.S.C §102 over Laing exists, and the same is respectfully requested.

Claims 9, 10, 11 and 12 remain rejected under 35 U.S.C §102(b) or, in the alternative 103 over Maruyama, et al. '242. It is assumed that this rejection is intended to be one over Laing *taken with* Maruyama, inasmuch as both references are discussed at page 6 of the September, 2003 Office Action. The deficiencies of Laing are discussed above and Maruyama does nothing to remedy the lack of a disclosure of an apparatus or method in which the components are structured so that heat flows as prescribed. Thus, this rejection should also be overturned.

Claim 5 also remains rejected under 35 U.S.C §103 over Laing taken with Fitch, et al., '321. The deficiencies of Laing are discussed at length above. Fitch, cited solely for the use of a particular phase change material, does nothing to remedy these deficiencies, and withdrawal this rejection is therefore also respectfully requested.

Claim 13 remains rejected under 35 U.S.C §103 over Laing taken with Bunyan, et al. '198. As noted above, Bunyan is cited for a particular feature of a dependent claim, and does

nothing to remedy the deficiencies of the primary reference. Thus, overturning of this rejection is also respectfully requested.

It is finally submitted that claims 20 and 21 are additionally patentable over the references, inasmuch as the references fail to suggest a device wherein the heat conducting unit (the fins) is in direct contact with the heat generating electric or electronic component, inasmuch as Laing, discussed above, disposes the phase change material between the heat conducting unit and the heat generating unit.

It is therefore respectfully submitted that the claims of the application are in condition for allowance, and overturning of all rejections is respectfully requested.

The Commissioner is hereby authorized to charge any fees associated with this response or credit any overpayment to Deposit Account No. 13-3402.

Respectfully submitted,

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Listing of Claims:

1. A device for cooling heat-generating electrical or electronic components having a non-uniform output profile, comprising a heat-conducting unit (1) and a heat-absorbing unit which contains a phase change material (4), wherein the phase change material is arranged in such a way that heat flow from the electrical or electronic component is_preferentially to the heat-conducting unit (1) and a majority of heat flow to the phase change material from the electrical or electronic component occurs only when the temperature of the heat-conducting unit (1) exceeds phase change temperature T_{PC} of the phase change material.

2. The device according to claim 1, wherein the phase change material-containing unit (4) contains at least one cavity (6) into which the phase change material has been introduced, where the cavities (6) are formed by the heat-absorbing unit (4).

3. The device according to claim 1, wherein the phase change material containing unit (4) additionally contains a liquid/gaseous heat transfer medium (5).

4. The device according to claim 3, wherein the liquid/gaseous heat transfer medium (5) is a halogenated hydrocarbon.

5. The device according to claim 1, wherein a solid-solid phase change material is employed.

6. The device according to claim 1, wherein the phase change material is encapsulated.

7. The device according to claim 1, wherein the heat-conducting unit (1) has surface area-increasing structures.

8. The device according to claim 1, wherein the heat-conducting unit (1) has cooling fins.

9. A component (Z), comprising a cooling device according to claim 1, a heat-generating electronic component having non-uniform output (2), wherein units (1), (4) and component (2) are arranged in such a way that the heat flow between the heat-generating electronic component (2) and the heat-conducting unit (1) takes place in direct contact.

10. A component (Z) according to claim 9, wherein the heat-generating electronic component (2) is a computer CPU or memory chip.

11. A computer containing a component (Z) according to claim 9.

12. An electronic data processing system containing a device according to claim 1.

13. A mobile communication power switch or power circuit, a mobile telephone or fixed transmitter transmission circuit, an electromechanical actuator control circuit, a satellite communication or radar application high frequency circuit, or a domestic appliance or industrial electronic actuator or control unit, comprising a device according to claim 1.

14. A device for absorbing heat from a heat source, said device, comprising a heat sink and a heat absorbing component containing a phase change material, wherein heat flows from the heat source to the heat sink and flows from the heat sink to the heat absorbing component when the heat sink temperature exceeds the phase change temperature of the phase change material.

15. A device for absorbing heat from a heat source, said device, comprising a heat sink means and a heat absorbing means containing a phase change material, wherein heat flows from the heat source to the heat sink and flows from the heat sink means to the heat absorbing means when the heat sink temperature exceeds the phase change temperature of the phase change material.

16. A device for absorbing heat, comprising, in contact with a heat-generating electric or electronic component, a heat sink and a heat absorbing component containing a phase change material, wherein heat flows from the heat generating electric or electronic component to the heat sink, and from the heat sink to the heat absorbing component when the heat sink temperature exceeds the phase change temperature of the phase change material.

17. A method for absorbing heat from a heat generating electronic or electric component, having a non-uniform output profile, comprising contacting said electric or electronic component with a heat sink and a heat absorbing component containing a phase change material, wherein heat flows from the heat sink to the heat absorbing component when the heat sink temperature exceeds the phase change temperature of the phase change material.

18. A method according to claim 17, wherein the heat sink temperature exceeds the phase change temperature of the phase change material at peak output of the electric or electronic component.

19. A method according to claim 17, wherein heat from the electric or electronic component flows directly to the heat sink.

20. A device according to claim 1, wherein the heat absorbing component is in direct contact with the electric or electronic component.

21. A device according to claim 14, wherein the heat absorbing component is in direct contact with the electric or electronic component.